

Measurement of J/ ψ in d+Au and p+p collisions at $\sqrt{s}_{NN}=200\text{GeV}$ with the PHENIX Muon Arms

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for the PHENIX collaboration

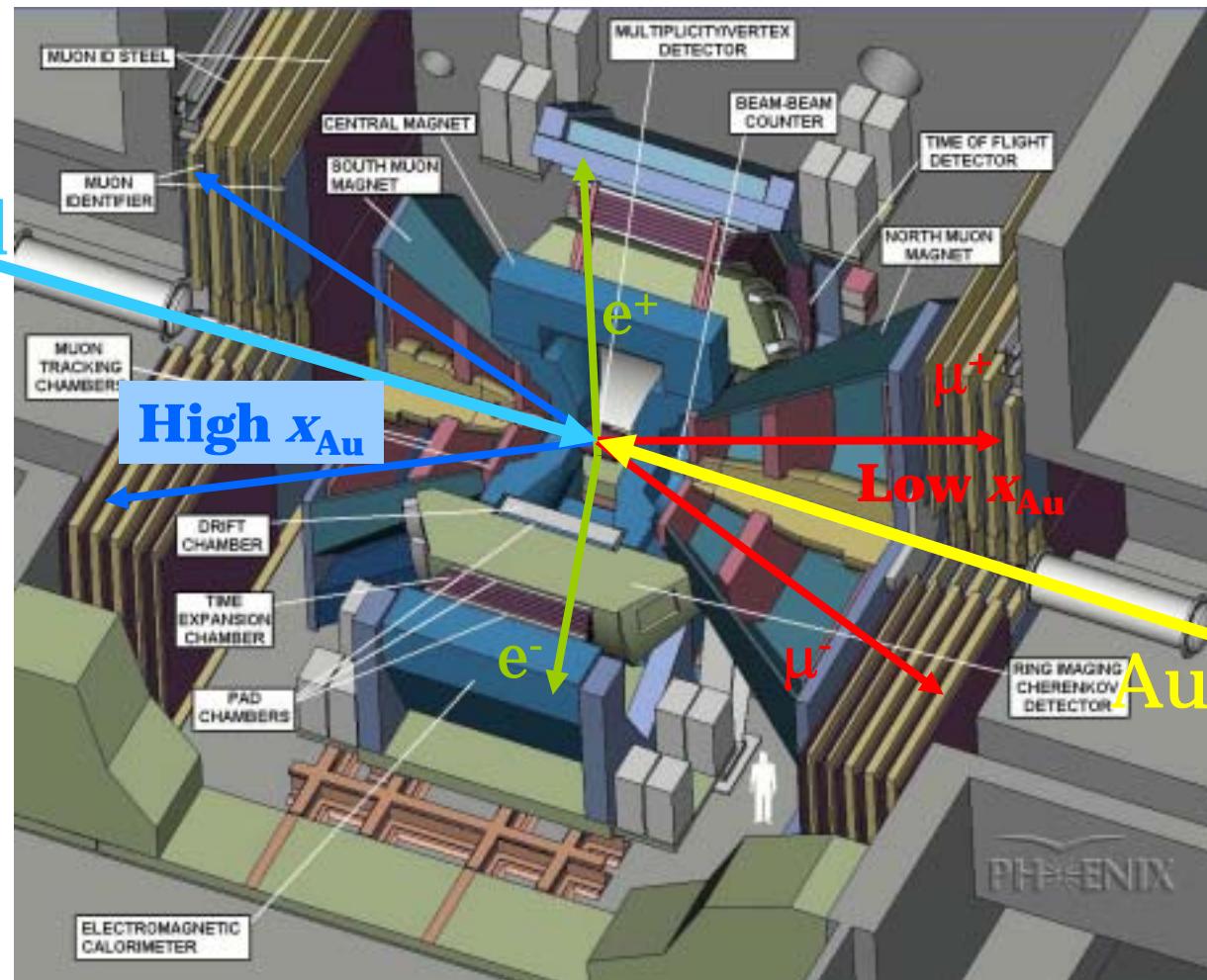
日本物理学会第59回年次大会
九州大学箱崎キャンパス
2004年3月29日

Physics motivation of dAu/pp \rightarrow J/ ψ

- **Study normal nuclear effects such as**
 - Shadowing & anti-shadowing of initial gluon distribution
 - J/ ψ (or c \bar{c}) absorption
 - p_T broadening (Cronin effect)

PHENIX is suitable for these studies with a broad acceptance in rapidity and p_T
- **Baseline for Au+Au collisions (J/ ψ yield as a probe for Quark Gluon Plasma)**

J/ ψ measurement with PHENIX



$J/\psi \rightarrow e^+e^-$

Two Central Arms

- $|\eta| < 0.35$
- $p > 0.2 \text{ GeV}$

$J/\psi \rightarrow \mu^+\mu^-$

Two Muon Arms

- $1.2 < |\eta| < 2.4$
- $p > 2 \text{ GeV}$

Centrality and vertex
given by
 $\text{BBC in } 3.0 < |\eta| < 3.9$

RHIC Run History

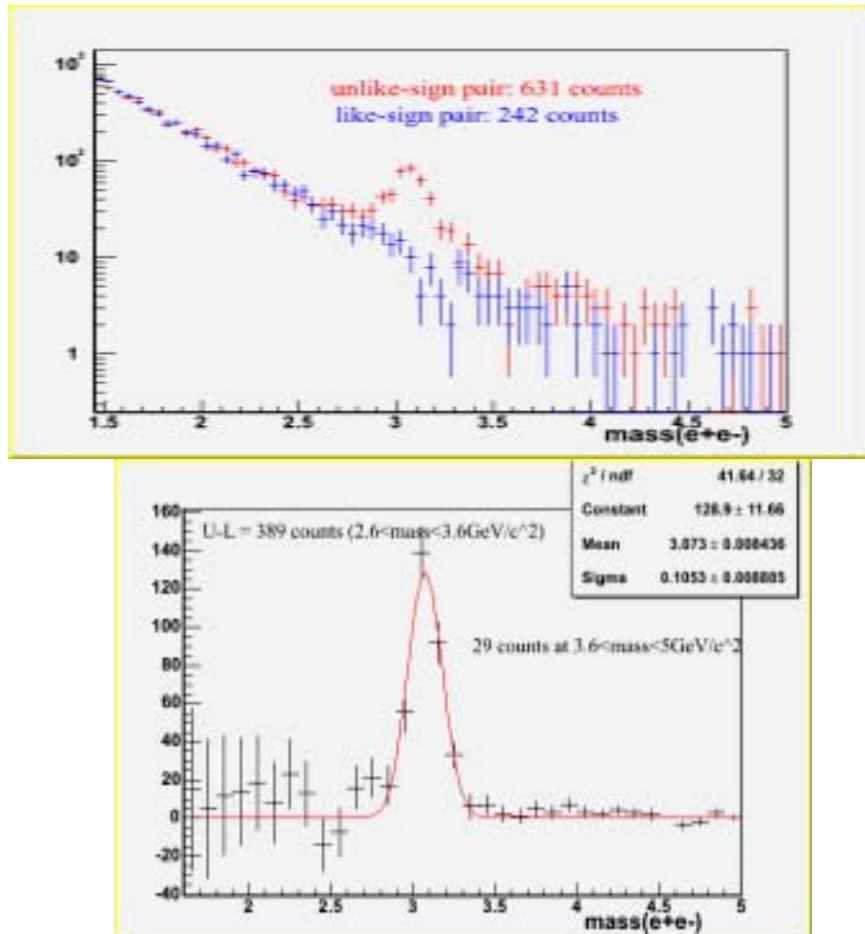
Year	Ions	\sqrt{s}_{NN}	Integrated Luminosity	Detectors	$N_{J/\psi}$
2000	Au+Au	130 GeV	$1 \mu\text{b}^{-1}$	Central	0
2001	Au+Au	200 GeV	$24 \mu\text{b}^{-1}$	Central	13 + 0 [1]
2002	p+p	200 GeV	0.15 pb^{-1}	+ 1 Muon Arm	46 + 66 [2]
2002	d+Au	200 GeV	2.74 nb^{-1}	Full = Central	300+800+600
2003	p+p	200 GeV	0.35 pb^{-1}	+ 2 Muon Arms	100+300+120
2004	Au+Au	200 GeV	$\sim 200 \mu\text{b}^{-1}$	Full	Talk by Taku Gunji ?

[1] Phys. Rev. **C69**, 014901 (2004)

[2] Phys Rev. Lett. **92**, 051802 (2004)

J/ ψ in d+Au

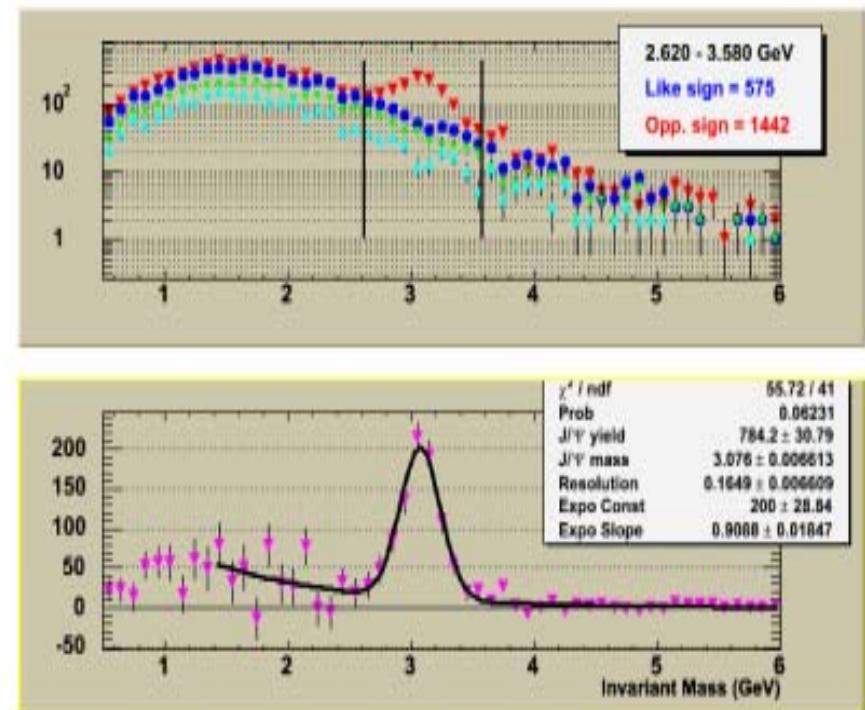
ee invariant mass



Mass Resolution ~ 100 MeV

Details will be given by Kametani

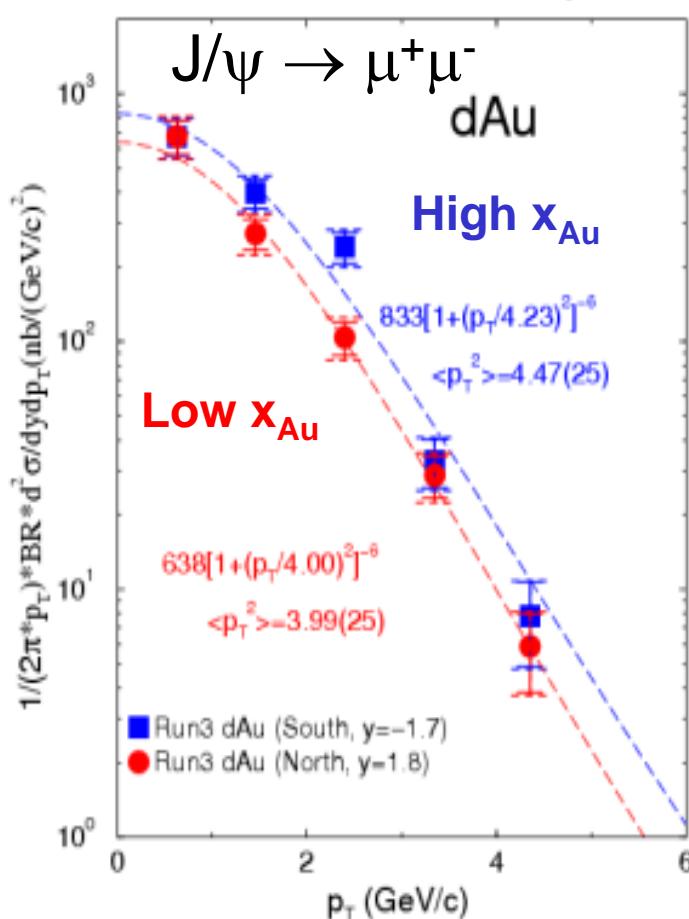
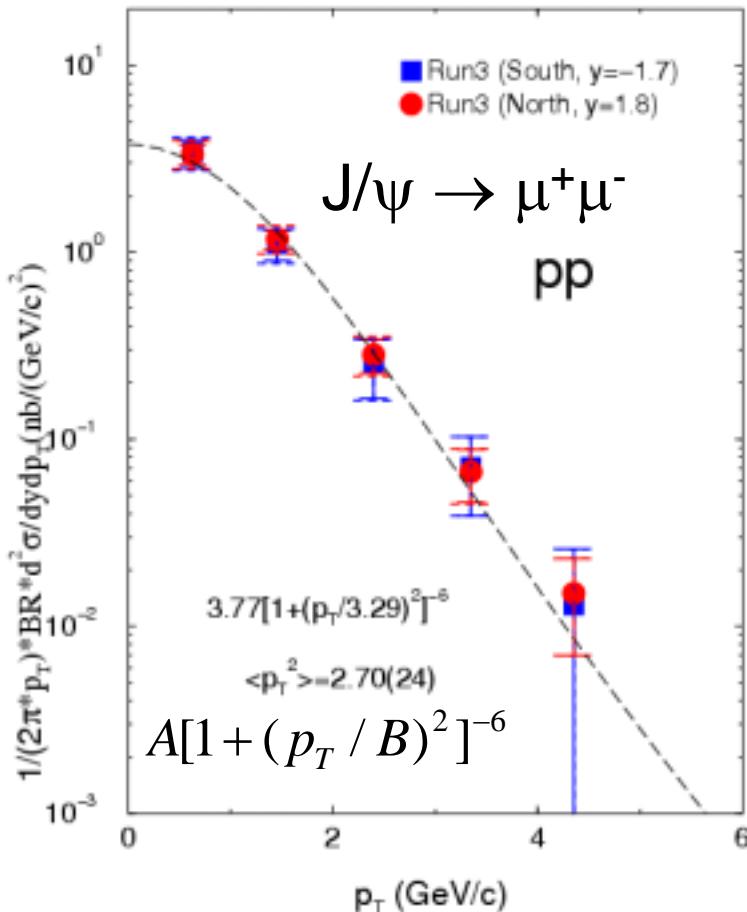
$\mu\mu$ invariant mass



Mass Resolution ~ 150 to 200 MeV

Cross section versus p_T

pp J/ ψ – PHENIX Preliminary

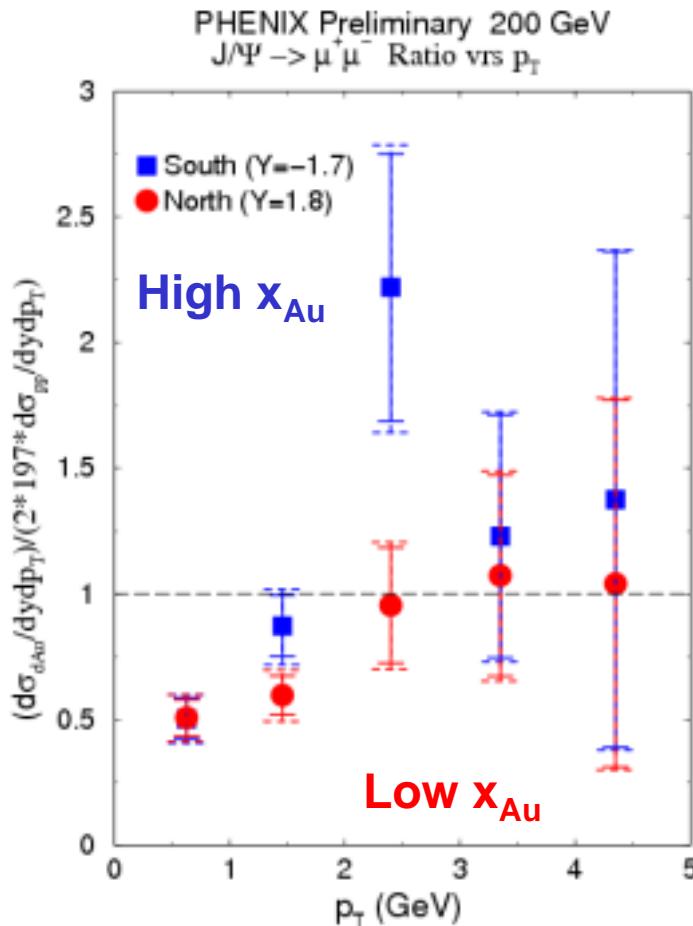


$$\begin{aligned}\Delta < p_T^2 > &\equiv < p_T^2 >_{\text{dAu}} - < p_T^2 >_{\text{pp}} \\ &= 1.77 \pm 0.35 \text{ GeV}^2 \text{ (high } x_{\text{Au}}\text{)} \\ &= 1.29 \pm 0.35 \text{ GeV}^2 \text{ (low } x_{\text{Au}}\text{)}\end{aligned}$$

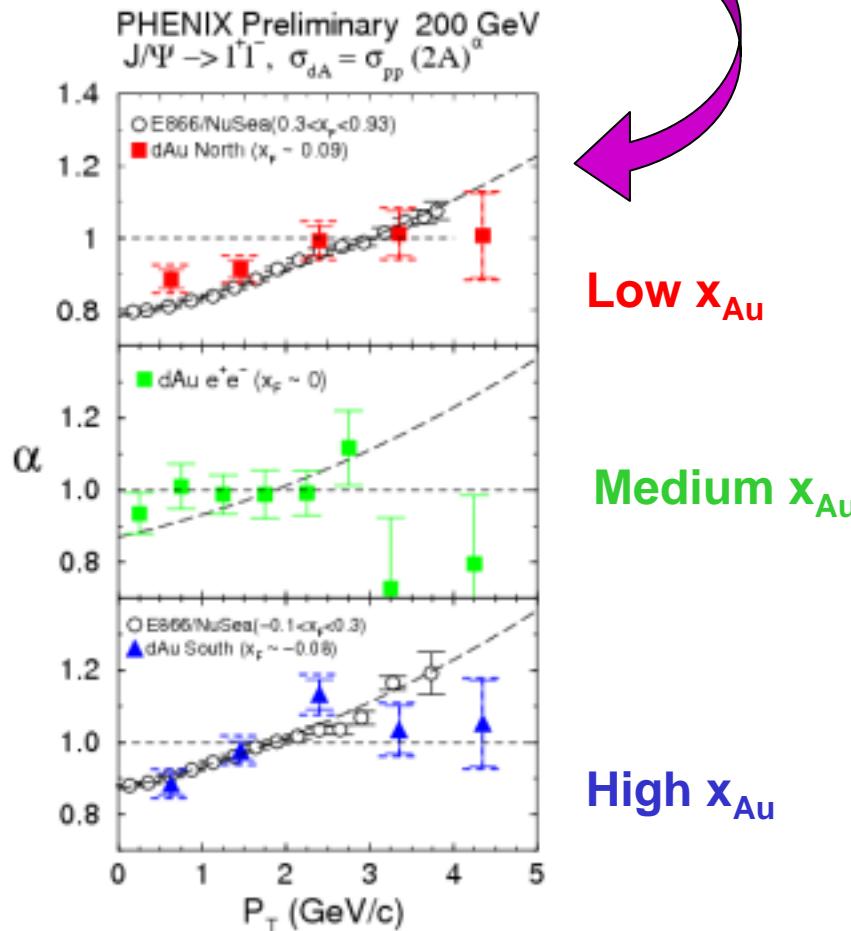
$\longrightarrow p_T$ broadening!

dAu/pp versus p_T

$$R = \sigma_{dA} / 2 \times 197 \times \sigma_{pp}$$

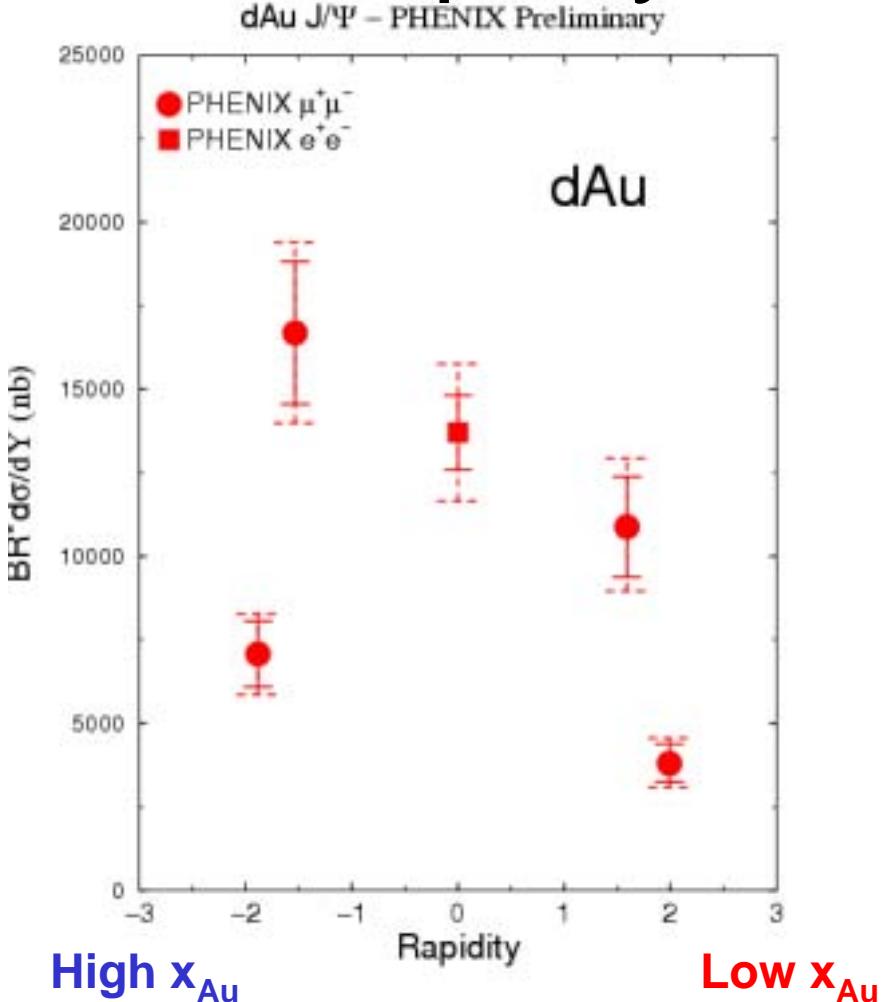
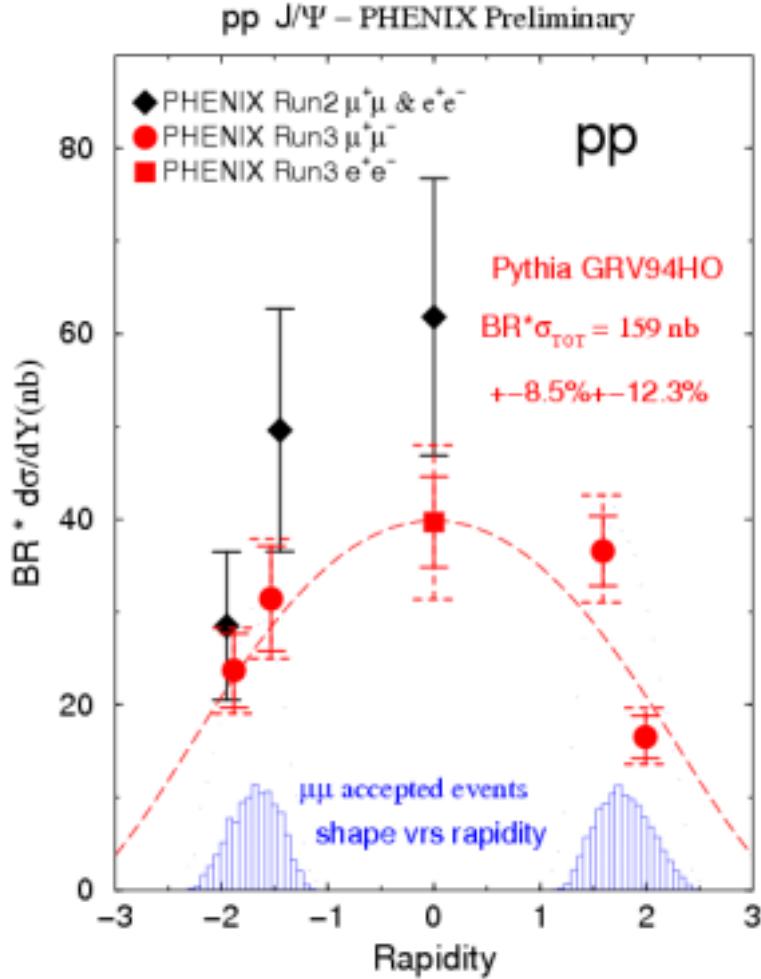


$$\sigma_{dA} = \sigma_{pp} (2 \times 197)^\alpha$$



Broadening comparable to lower energy

Cross section versus rapidity

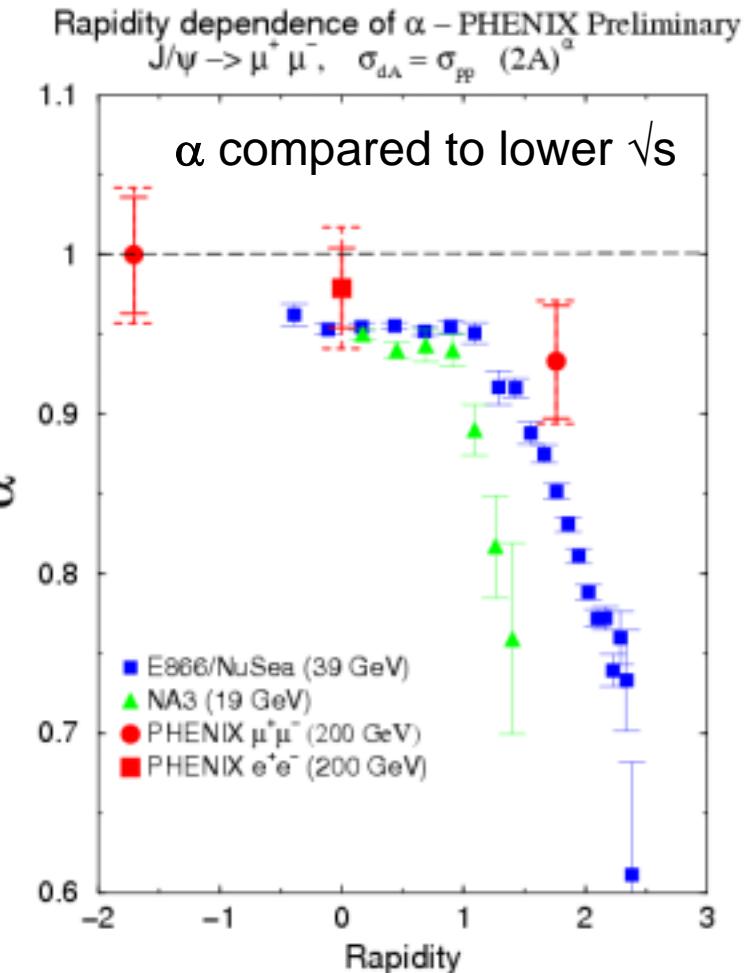
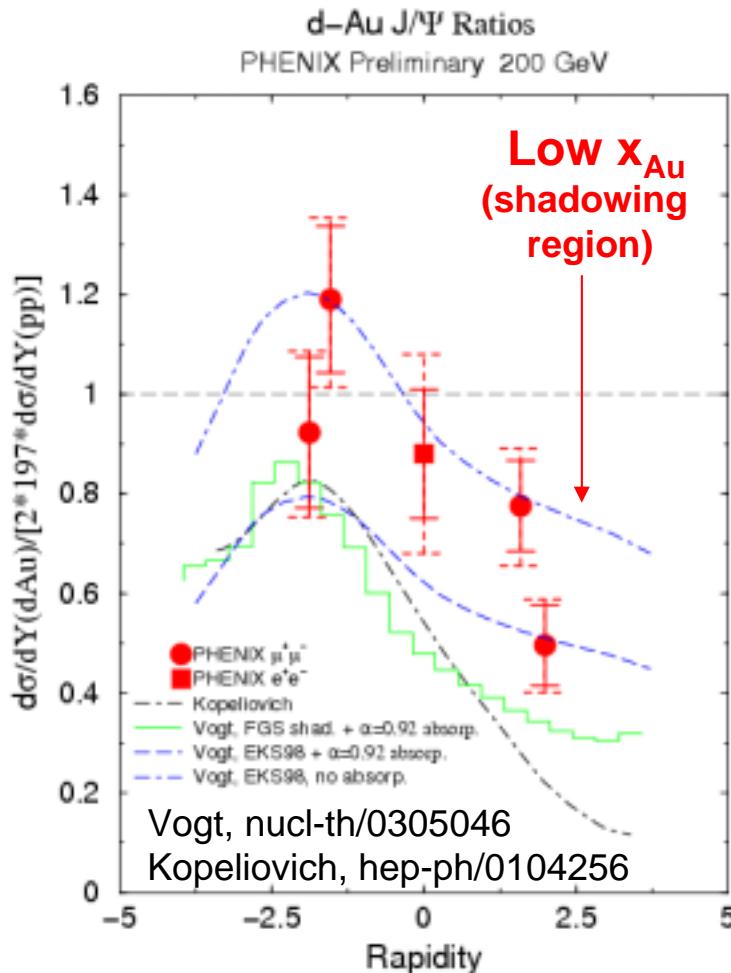


- Total cross section in p+p

$\text{Br } (J/\psi \rightarrow l^+l^-) \sigma_{\text{pp}} = 159 \text{ nb} \pm 8.5 \% \text{ (fit)} \pm 12.3 \% \text{ (abs.)}$

Consistent with the Run-2 result within 1.5σ

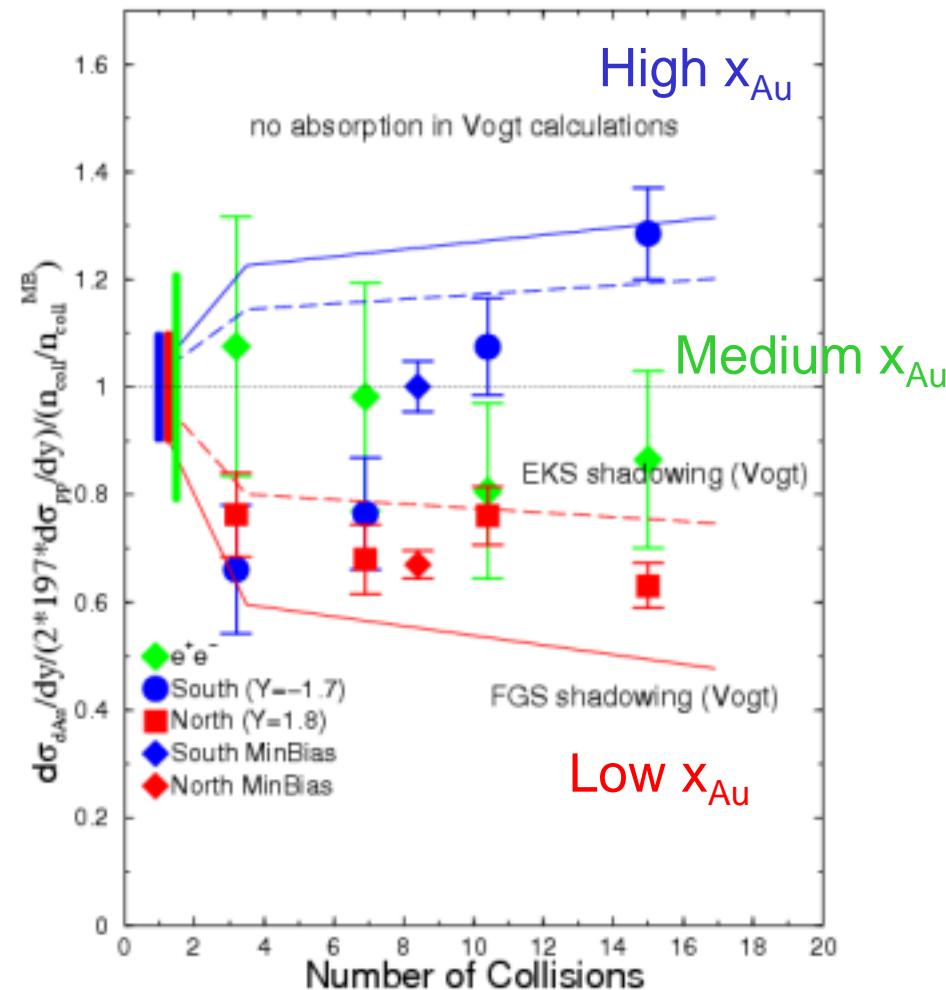
dAu/pp versus rapidity



- Data favours (weak) shadowing + (weak) absorption
- With limited statistics difficult to disentangle nuclear effects

dAu / pp versus N_{coll}

PHENIX Preliminary 200 GeV
 $\text{J}/\Psi \rightarrow \ell^+ \ell^-$ vrs Number of Collisions



$$R = \frac{\sigma_{\text{dA}} \times \langle N_{\text{coll}}^{\text{MB}} \rangle}{2 \times 197 \times \sigma_{\text{pp}} \times \langle N_{\text{coll}} \rangle}$$

- Number of nucleon binary collisions (N_{coll}) is determined using BBC hits and Glauber model → Related to the centrality of the dAu collision
- Low x_{Au} shape consistent with shadowing models
- High x_{Au} shape steeper than corresponding anti-shadowing
 - What could it be ?

Conclusios

- We have seen nuclear effects in J/ψ production in d+Au collisions at $\sqrt{s}_{NN} = 200$ GeV
 - p_T broadening is similar to lower energy results
 - Weak shadowing (anti-shadowing) and weak absorption reproduce our rapidity distribution well
 - Rising σ_{dA}/σ_{pp} versus centrality at high x_{Au} (~ 0.1) → Can not explained by anti-shadowing ?
- More statistics is useful to disentangle these effects
- No large nuclear effect → good news to see J/ψ suppression in Au+Au